

REMARKS

1. The Patent Office Action of December 1, 2005 is hereby acknowledged. The shortened statutory period of three (3) months time period for response to the Office Action expired on March 1, 2006. This Continuation Application is being mailed by United States Express Mail, Express Mail Label No. EV 699609533US in a postage paid envelope addressed to MAIL STOP RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on April 28, 2006. Concurrently with the filing of this Continuation Application, the Applicant has requested a two-month extension of time and has paid the required fee of \$225.00. Accordingly, the deadline to now file a responsive Continuation Application is May 1, 2006. Therefore, this Continuation Application is timely filed. In the event that the Commissioner for Patents should determine that any additional fee is required for this Continuation Application to be timely filed and an appropriate fee is due for that extension of time, then the Commissioner for Patents is hereby authorized to charge Deposit Account Number 18-2222 for such appropriate fee.

2. In addition, the Applicant has paid fee for the Continuation Application in the amount of \$395.00. In the event that the Commissioner for Patents should determine that any additional fee is required for this Continuation Application, then the Commissioner for Patents is hereby authorized to charge Deposit Account Number 18-2222 for such appropriate fee.

3. The Examiner has finally rejected all pending claims of invention under 35 U.S.C. 102(b) as being anticipated by published patent application US 2002/0021779 A1 to Murakami et al. published on February 21, 2002 for "ALUMINUM COMPOSITE MATERIAL, ALUMINUM COMPOSITE POWDER AND ITS MANUFACTURING METHOD, SPENT FUEL STORAGE MEMBER AND ITS MANUFACTURING METHOD" (hereafter "Murakami"). The Applicant very respectfully disagrees with the

1 Patent Examiner for the final rejection.

2 3.01 A reason that the Applicant very respectfully disagrees with the  
3 Patent Examiner is simply because '766 Application is structurally different from the  
4 Murakami publication. Therefore, a judgement of anticipation under 35 U.S.C. § 102(b) is  
5 unreasonable. For establishing a prima facie case of anticipation, the Federal Circuit states  
6 that under 35 U.S.C. § 102(b), " There must be no difference between the claimed invention  
7 and reference disclosure, as viewed by a person of ordinary skill in the field of invention."  
8 *Scripps Clinic & Research Found. V. Genentech Inc.*, 927 F.2d 1576, and furthermore, the  
9 Federal Circuit states under 35 U.S.C. § 102, "anticipation requires the presence in a single  
10 prior art reference disclosure of each and every element of the claimed invention, arranged  
11 as in the claim" *Lindemann Maschinenfabrik GmbH V. American Hoist & Derrick Co.*,  
12 221 USPQ 481. Therefore, for the prima facie case of anticipation, following listed factors  
13 must be present, or a case of anticipation is not met: (1) a single reference (2) that teaches  
14 or enables (3) each of the claimed elements (as arranged in the claim) (4) either expressly  
15 or inherently and (5) as interpreted by one of ordinary skill in the art. Thus the Applicant  
16 respectfully provides the Examiner with the following structurally different elements  
17 between the cited Murakami publication and the '766 Application as a basis for the '766  
18 Application being allowable.

19 3.02 In summary, one of ordinary skill in art of materials science and  
20 engineering can easily find differences between the structural elements cited in the  
21 Murakami publication and the '766 Application, wherein said differences are listed in  
22 following table:  
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24  
25  
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28

	the Murakami invention for a regular composite.	The '766 Application for a nanocomposite
Aluminum particles as the matrix phase of the composite	1) Added into the mixture of composite at the very beginning of the manufacturing processes 2) Particle being flatten in a step of mechanical alloying	1) <i>in situ</i> Formed in the consolidation step and subsequent metal working from prepared aluminum or aluminum alloy particles with nano-scale surface aluminum oxide 2) No flatten in particle shape
Aluminum oxide particles as the third phase of the composite	1) Size: 0.01 to 10 $\mu\text{m}$ <u>Option A:</u> 1) Added into the mixture at the very beginning of the manufacturing processes 2) Ground in the step of mechanical alloying to change size to be smaller <u>Option B:</u> 1) Formed in the step of mechanical alloying, but the amount is uncontrollable 2) Ground in the step of mechanical alloying to be a smaller size	1) Size: 0.01 to 0.8 $\mu\text{m}$ 2) Chemically formed in the step of preparing the nano aluminum oxide surface aluminum powder for the nano phase 3) Amount of aluminum oxide in the surface layer is quantitatively controllable 4) <i>in situ</i> Formed in the consolidation step and subsequent metal working
Particles of the second phase	Particles of neutron absorber are ground in the step of mechanical alloying to be a smaller size	No mention for particle size change for the reinforce phase

3.03 The Murakami publication discloses a totally different process to make a different composite, in comparison with the '766 Application. Specifically, the difference concerns the aluminum particle, the neutron absorber particle, and the third particle.

3.03.01 In Murakami the aluminum particle, said particle is added into the composite mixture powders from *the steps of mixing aluminum powder as matrix material* [0009], and "By MA (*mechanical alloyed*), the Al powder or Al alloy powder is crushed by the balls, and plaited and flattened" [0048].

3.03.02 In Murakami the particle size of the neutron absorber changes to be smaller in the process of mechanical alloying, from "*the neutron absorber such as B is also finely ground by mechanical alloying*" [0010]. This structural element of finely grounding is also proven by experimental results of the Murakami publication, for

1 example, a mean particle size ( $\mu\text{m}$ ) of BN is from 3 to 0.8 [0083].

2 3.03.03 For the third particle in Murakami, the difference involves  
3 issues on (1) origin of the third particle and (2) change of said particle in manufacturing  
4 processes.

5 In one embodiment of the Murakami invention for the third  
6 particle composed of aluminum oxide, said third particle is added into the matrix of  
7 aluminum along with the added neutron absorber, which can be seen in the following  
8 copied statement and also in the section of "EXAMPLE" [0081], wherein the Murakami  
9 reference states that " *the aluminum composite powder according to one aspect of the*  
10 *present invention is obtained by employing mechanical alloying, and dispersing neutron*  
11 *absorber, and third particle composed of oxide, nitride, carbide or boride ground by*  
12 *mechanical alloying in aluminum matrix*" [0007], and " *The manufacturing method of*  
13 *aluminum composite powder according to another aspect of the present invention*  
14 *comprises the steps of mixing aluminum powder as matrix material, neutron absorber, and*  
15 *third particle composed of oxide, nitride, carbide or boride, and dispersing the ground*  
16 *neutron absorber and third particle in the aluminum matrix by mechanical alloying of the*  
17 *matrix powder*" [0009]. In addition, the size of the third particle changes to be smaller in  
18 the process of mechanical alloying, from "in the invention, moreover, the third particle  
19 composed of oxide or like is finely ground" [0010] by the process of "mechanical alloying"  
20 [0010]. This structural element of finely grounding is also proven by experimental results  
21 of the Murakami publication, for example, a mean particle size ( $\mu\text{m}$ ) of  $\text{Al}_2\text{O}_3$  is from 0.5  
22 to 0.3 [0083].

23 In another embodiment of the Murakami invention for the  
24 third particle composed of aluminum oxide, said third particle is from "When using the  
25 oxide as the third particle, the oxide is not added separately, but is preliminarily formed as  
26 an oxide film on the surface of the aluminum powder, and this oxide film is peeled and  
27 ground at the time of mechanical alloying, and is dispersed in the matrix as the third  
28 particle" [0011]. The Murakami invention clearly states the third particle is formed in the

1 step of mechanical alloying, wherein the aluminum oxides on the outside layer of the  
2 aluminum metal particles are peeled, and further finely ground. However, there is no  
3 disclosure that the amount of oxides can be purposely controlled.

4 The Murakami invention also discloses a preferred mean  
5 particle size of the third particle is from 0.01 to 10  $\mu\text{m}$  [0008], and weight content of said  
6 particle is from 0.1 to 30% for the total weight of the composite [0008].

7 3.04 The '766 Application utilizes a different way to make the different  
8 third particle and aluminum particle in the composite, in contrast to that from the Murakami  
9 invention.

10 3.04.1 In the '766 Application, the third particle of nano scale  
11 aluminum oxide, said difference involves the following features. First, the nano scaled  
12 aluminum oxides for the third phase in the composite is chemically formed exclusively in a  
13 process of "Step 1. Preparing the Nano-Al<sub>2</sub>O<sub>3</sub>-surface Aluminum Powder for the Nano  
14 Phase" (Page 5, Lines 17-18). Second, the third phase of nano scaled aluminum oxides in  
15 the composite can be objectively and quantitatively controlled in the process of Step 1,  
16 wherein the '766 Application can base on an invented equation to purposely control the  
17 amount of the nano-scale aluminum oxide on the surface of the aluminum metal particle.  
18 This can be seen from the specification that "the total volume percentage of nano-scale  
19 Al<sub>2</sub>O<sub>3</sub> on a spherical shaped aluminum powder, the size of average aluminum powder  
20 particle size D and the thickness of the nano-scale Al<sub>2</sub>O<sub>3</sub> layer have a relationship defined  
21 by Equation [2]:  $N_{Al} = 1 - (1 - 2T/D)^3$ " (Page 7, Lines 3-8). Third, "The nano phase will be  
22 created by breaking the nano Al<sub>2</sub>O<sub>3</sub> surface layer on the aluminum particles during the  
23 consolidation step (Step 3) and subsequent metalworking" (Page 9, Lines 16-18), which  
24 means the nano phase is *in situ* formed inside of the composite. The '766 Application  
25 clearly states that the breaking the nano Al<sub>2</sub>O<sub>3</sub> surface layer on the aluminum particles is  
26 not happed in the "Step 2, Preparing Powder Mixture", wherein the objective of "Step 2" in  
27 the '766 Application is similar to a function of mixing powders of the three phase materials  
28 in the step of "*mechanical alloying*" in spite of the second purpose of grounding particles

1 from the Murakami invention. Fourth, a range of the nano-scale aluminum oxide average  
2 particle size is from 10 nm to about 800 nm, which is up to 12 times smaller than the range  
3 of 0.01 to 10  $\mu$ m disclosed in the Murakami invention.

4 Based on above mentioned characteristics of the structure of the  
5 nano-scale aluminum oxide phase, which is substantially different from that of the third  
6 phase in the Murakami invention, the independent Claim 1, element "b" of the '766  
7 Application is currently amended to:

8  
9 "b. a nano-scale aluminum oxide phase, comprising nano-scale aluminum oxide  
10 particles in said nanocomposite, said nano-scale aluminum oxide particles  
11 are prepared from aluminum or aluminum alloy particles with nano-scale  
12 surface aluminum oxide composed of an aluminum metal or aluminum alloy  
13 inside of said aluminum or aluminum alloy particles and an aluminum oxide  
14 layer on the outside of said aluminum or aluminum alloy particles , said  
15 nano-scale aluminum oxide phase is from said aluminum or aluminum alloy  
16 particles wherein said outside layer of aluminum oxides of said aluminum or  
17 aluminum alloy particles is broken in the processes of making said  
18 nanocomposite, wherein said breaking of said aluminum oxide layer of said  
19 aluminum or aluminum alloy particles does not happen in a step to make a  
20 powder mixture of said nanocomposite, and said breaking of said aluminum  
21 oxide layer happens during a consolidation step and subsequent metal  
22 working step, further an amount of said nano-scale aluminum oxide phase in  
23 said nanocomposite is quantitatively controllable in a step of making said  
24 aluminum or aluminum alloy particles with nano-scale surface aluminum  
25 oxide,"

26  
27 With the invention as now claimed for the nano-scale aluminum  
28 oxide phase, it is respectfully submitted that the present invention of the nano-scale

aluminum oxide phase is not anticipated under 35 U.S.C. § 102 by the Murakami reference.

3.04.2 For the aluminum particle, said difference is that (1) the aluminum particles are *in situ* generated in the consolidation step (Step 3) and subsequent metalworking” after the outside layer of aluminum oxide is broken from the aluminum or aluminum alloy particles with nano-scale surface aluminum oxide . Therefore, there are no *plaited and flattened* aluminum particles, which occur in the Murakami invention.

Based on the above mentioned characteristics of the structure of the aluminum alloy phase, which is substantially different from that in the Murakami invention, the independent Claim 1, element “a” of the ‘766 Application is currently amended to read:

“a. an aluminum alloy phase, which phase is formed during a consolidation step and a subsequent metal working step from the aluminum or aluminum alloy particles with nano-scale surface aluminum oxide composed of an aluminum metal or aluminum alloy inside of said particles and an aluminum oxide layer on the outside of said particles”

With the invention as now claimed for the aluminum alloy phase, it is respectfully submitted that the present invention of the aluminum alloy phase is not anticipated under 35 U.S.C. § 102 by the Murakami reference.

3.05 In conclusion, the ‘766 Application is structurally different from the Murakami invention.

4. With the invention as now claimed, it is respectfully submitted that the present invention is not anticipated by the Murakami reference.

Further due to the novelty of combining nano scaled third phase particles and micro scaled reinforced phase particles in the aluminum matrix, the ‘766 Application possesses much better mechanical properties than the Murakami invention, including better

1 strength and strain provided by the nano scaled third phase, and higher elastic moduli and  
2 lower thermal expansion coefficient contributed from the micro scaled reinforced phase.  
3 The Applicants have provided analysis to demonstrate said better mechanical properties of  
4 the invention disclosed and claimed in the '766 Application as compared to Murakami,  
5 which analysis is set forth in Appendix I of the Amendment attached hereto and  
6 incorporated herein by reference.

7  
8 5. Therefore, with the claims of invention as now amended, it is respectfully  
9 submitted that the present '766 Application is now in condition for allowance and issuance  
10 of a Notice of Allowance of the '766 Application is respectfully solicited.

11 Respectfully submitted,

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## APPENDIX I

### Analysis

Several composites that have been made in according to techniques disclosed by the '766 Application. The composites have employed 16 micron diameter treated aluminum powder that contains 3.5 percent of the nano oxide plus either 5 or 10 volume percent of a micron size reinforcement. Composite 1 contains 5-volume percent silicon carbide in a nano-7 matrix alloy. This composite was extruded into 0.5 inch diameter rods, cut into sample blanks, heat treated, machined into tensile samples and tested at room temperature. Composite 2 contains 10 volume percent aluminum oxide particles in a nano-2 matrix alloy. This material was extruded into 0.5 inch diameter rod, cut into sample blanks, heat treated to a T-6 condition, exposed at 200\_C for 100 hours, machined into tensile samples and tested at 200\_C. The data for these two composites are contained in Table 1. Also contained in Table 1 are data from Mirakami, Table 4. Table 1 separates the amount of reinforcements by the size range of the reinforcement; particles with sizes less than 0.5 micrometers are listed as nano scale and particles greater than 0.5 micrometers are listed as micro scale.

Table 1

Composite Description	Content, Size	Content, Size	Test	Ultimate	Strain at
	Nano< 0.5 $\mu$ m	Micro> 0.5 $\mu$ m	Temperature	Strength	Failure
	(Mass %)	(Mass %)	( _ C )	(MPa)	(%)
Nano-7/SiC/5p T-6P	3.5, Nano	5.65	23	696	6.5
Nano-2/Al <sub>2</sub> O <sub>3</sub> /10p T-6P	3.5, Nano	13.3	23	503	3.5
Nano-2/Al <sub>2</sub> O <sub>3</sub> /10P					
100 Hr at 200 _C	3.5, Nano	13.3	200	335	4.5
Mirakami Tbl 4-1	5, Micro	0	200	350	5
Mirakami Tbl 4-2	0	5	200	330	4
Mirakami Tbl 4-3	0	5	200	260	2
Mirakami Tbl 4-4	0.05, Micro	0	200	282	6
Mirakami Tbl 4-5	1	0	200	300	5.5
Mirakami Tbl 4-6	35, Micro	0	200	380	1
Mirakami Tbl 4-7	0	5	200	340	4
Mirakami Tbl 4-8	0	5	200	320	5
Mirakami Tbl 4-9	0	5	200	335	4.5

These data demonstrate that by controlling the amount of the nano-scale and the micro scale reinforcements, good combinations of high strength and ductility can be achieved both at room temperature and at 200\_C. Note that the strength and strain at failure values listed here are for materials that contain 9 weight percent and 17 weight percent of total reinforcement as opposed to 5 weight percent reinforcement for the composites reported in Mirakami. Two materials reported by Mirakami, 4-4 and 4-6 contained a smaller or larger amount of reinforcement and had too low a strength or severely limited strain at failure. By adding the combination of nano-scale and micro scale reinforcements, the composites based on the '766 Application possess higher elastic moduli, lower coefficients of thermal expansion and other engineering properties that are controlled by the micro scale reinforcements. These properties are achieved while maintaining high strength and strain at failure due to the superior distribution of the nano scale reinforcement provided by the techniques of the '766 Application.